

What is claimed is:

1 1. An electrode material comprising a surface/chemically modified positive  
2 electrode (cathode) material, wherein the surface/chemical modification is a ceramic.

1 2. The composition of claim 1, wherein the surface/chemical modification is  
2 selected from the group consisting of  $\text{Li}_x\text{Ni}_{1-y}\text{M}_y\text{O}_2$ , where  $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ , and M  
3 = Mg, Al, Ti, V, Cr, Fe, Co, Cu, Zn, and Ga;  $\text{Al}_2\text{O}_3$ ;  $\text{Cr}_2\text{O}_3$ ;  $\text{MgO}$ ;  $\text{Al}_{2-y}\text{Mg}_y\text{O}_{3-0.5y}$   
4 where  $0 \leq y \leq 2$ ;  $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$  where  $0 \leq x \leq 0.33$ ,  $0 \leq y \leq 2$  and M = Mg, Al, Ti,  
5 V, Cr, Fe, Co, Ni, Cu and Zn;  $\text{Zr}_{1-y}\text{M}_y\text{O}_{2-y}$  where  $0 \leq y \leq 1$  and M = Mg, Ca;  $\text{Zr}_{1-y}\text{M}_y\text{O}_{2-0.5y}$   
6 where  $0 \leq y \leq 1$  and M = Sc, Y; and a combinations thereof.

1 3. The composition of claim 1, wherein the positive electrode (cathode) material is  
2 selected from the group consisting of  $\text{LiCoO}_2$ ,  $\text{LiMn}_2\text{O}_4$ ,  $\text{LiNi}_{1-y}\text{Co}_y\text{O}_2$  where  $0 \leq y \leq 1$   
3 and  $\text{LiMn}_{1-y}\text{M}_y\text{O}_2$  where M = Cr and Al and  $0 \leq y \leq 1$ , and  $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_{4-z+\delta}\text{X}_z$   
4 where  $0 \leq x \leq 0.33$ ,  $0 \leq y \leq 1$ ,  $0 \leq \delta \leq 0.5$ , M = Mg, Al, Ti, V, Cr, Fe, Co, Ni, Cu and  
5 Zn, and X = F and S.

1 4. The composition of claim 1, wherein the positive electrode (cathode) material is  
2  $\text{LiMn}_2\text{O}_4$ .

1 5. The composition of claim 1, wherein the positive electrode (cathode) material is  
2  $\text{LiCoO}_2$ .

1 6. The composition of claim 1, wherein the surface/chemical modification material  
2 is  $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$ , where  $0 \leq x \leq 1$ ;  $0 \leq y \leq 1$ .

1 7. The composition of claim 1, wherein the surface/chemical modification material  
2 is  $\text{Al}_2\text{O}_3$ .

1 8. The composition of claim 1, wherein the surface/chemical modification material  
2 is  $\text{MgO}$ .

1 9. The composition of claim 1, wherein the surface/chemical modification material  
2 is MgAl<sub>2</sub>O<sub>4</sub>.

1 10. The composition of claim 1, wherein the surface/chemical modification material  
2 is Li<sub>1.05</sub>Mn<sub>1.9</sub>Ni<sub>0.05</sub>O<sub>4</sub>.

1 11. The composition of claim 1, wherein the surface/chemical modification material  
2 is Cr<sub>2</sub>O<sub>3</sub>.

1 12. An electrode material comprising a LiMn<sub>2</sub>O<sub>4</sub> spinel oxide having been  
2 surface/chemically modified with a surface/chemical modification material selected  
3 from the group consisting of Li<sub>x</sub>Ni<sub>1-y</sub>Co<sub>y</sub>O<sub>2</sub>, where 0 ≤ x ≤ 1; 0 ≤ y ≤ 1; Al<sub>2</sub>O<sub>3</sub>; Cr<sub>2</sub>O<sub>3</sub>;  
4 MgO; MgAl<sub>2</sub>O<sub>4</sub>; and a combinations thereof.

1 13. The composition of claim 11, wherein the surface/chemical modification  
2 material is Li<sub>x</sub>Ni<sub>1-y</sub>Co<sub>y</sub>O<sub>2</sub>, where 0 ≤ x ≤ 1; 0 ≤ y ≤ 1.

1 14. The composition of claim 11, wherein the surface/chemical modification  
2 material is Al<sub>2</sub>O<sub>3</sub>.

1 15. The composition of claim 11, wherein the surface/chemical modification  
2 material is MgO.

1 16. The composition of claim 11, wherein the surface/chemical modification  
2 material is MgAl<sub>2</sub>O<sub>4</sub>.

1 17. The composition of claim 11, wherein the surface/chemical modification  
2 material is Cr<sub>2</sub>O<sub>3</sub>.

1 18. An electrode material comprising a LiCoO<sub>2</sub> layered oxide having been  
2 surface/chemically modified with a surface/chemical modification material selected  
3 from the group consisting of Al<sub>2</sub>O<sub>3</sub>; Cr<sub>2</sub>O<sub>3</sub>; MgO, MgAl<sub>2</sub>O<sub>4</sub>; Li<sub>1+x</sub>Mn<sub>2-x-y</sub>M<sub>y</sub>O<sub>4</sub> where 0  
4 ≤ x ≤ 0.33, 0 ≤ y ≤ 2 and M = Ni or Co; and a combinations thereof.

1 19. The composition of claim 17, wherein the surface modification material is  
2  $\text{Al}_2\text{O}_3$ .

1 20. The composition of claim 17, wherein the surface modification material is  
2  $\text{Li}_{1.05}\text{Mn}_{1.9}\text{Ni}_{0.05}\text{O}_4$

1 21. An electrode material preparation method comprising:  
2 supplying a  $\text{LiMn}_2\text{O}_4$  spinel oxide electrode material;  
3 mixing the  $\text{LiMn}_2\text{O}_4$  spinel oxide electrode material with a surface/chemical  
4 modification material selected from a group consisting of  $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$ , where  $0 \leq x \leq$   
5 1;  $0 \leq y \leq 1$ ;  $\text{Al}_2\text{O}_3$ ;  $\text{Cr}_2\text{O}_3$ ;  $\text{MgO}$ ;  $\text{MgAl}_2\text{O}_4$ ; and combinations thereof; and  
6 heat-treating the mixture to prepare a surface/chemically modified  $\text{LiMn}_2\text{O}_4$   
7 electrode material.

1 22. The method of claim 20, wherein the heat-treating is performed at a temperature  
2 in the approximate range of 100°C to 1000°C.

1 23. The method of claim 20 wherein the heat-treating is performed for  
2 approximately 1 to 24 hours.

1 24. The method of claim 20, wherein the surface/chemical modification material is  
2 in the approximate range of 1 to 20 weight percent of the surface/chemically modified  
3  $\text{LiMn}_2\text{O}_4$  electrode material.

1 25. An electrode material comprising a surface/chemically modified  $\text{LiMn}_2\text{O}_4$   
2 spinel oxide said electrode material prepared by a process comprising:  
3 a) refluxion of a precursor solution in glacial acetic acid, wherein the precursor  
4 is selected from a group consisting of  $\text{Li}_x\text{CoO}_2$ ,  $\text{LiCo}_{0.5}\text{Ni}_{0.5}\text{O}_2$ , and  $\text{Al}_2\text{O}_3$ ;  
5 b) preparing a precursor solution in water, wherein the precursor is selected  
6 from a group consisting of  $\text{Al}_2\text{O}_3$ ;  $\text{Cr}_2\text{O}_3$ ;  $\text{MgO}$ , and  $\text{MgAl}_2\text{O}_4$ ;  
7 c) dispersing  $\text{LiMn}_2\text{O}_4$  spinel oxide in the precursor solution; and  
8 d) heating the dispersed  $\text{LiMn}_2\text{O}_4$  spinel oxide to approximately 100 to 500  
9 degrees C; and

e) firing the heated dispersed  $\text{LiMn}_2\text{O}_4$  spinel oxide at 500 to 900 degrees C.

1 26. A method of preparing an electrode material for lithium-ion batteries  
2 comprising:

3 supplying a LiCoO<sub>2</sub> layered oxide electrode material;

4 mixing the LiCoO<sub>2</sub> layered oxide electrode material with a surface/chemical  
5 modification material selected from a group consisting of Al<sub>2</sub>O<sub>3</sub>; Cr<sub>2</sub>O<sub>3</sub>; MgO,  
6 MgAl<sub>2</sub>O<sub>4</sub>; Li<sub>1+x</sub>Mn<sub>2-x-y</sub>MyO<sub>4</sub> where 0 ≤ x ≤ 0.33, 0 ≤ y ≤ 2 and M = Ni or Co; and  
7 combinations thereof; and

8 heat-treating the mixture to prepare a surface/chemically modified LiCoO<sub>2</sub>  
9 electrode material.

1 27. The method of claim 23, wherein the heat-treating is performed at a temperature  
2 in the approximate range of 100°C to 1000°C.

1 28. The method of claim 23 wherein the heat-treating is performed for  
2 approximately 1 to 24 hours.

1 29. The method of claim 25, wherein the surface/chemical modification material is  
2 in the approximate range of 1 to 20 weight percent of the surface/chemically modified  
3 LiCoO<sub>2</sub> electrode material.

1 30. An electrode material comprising a surface/chemically modified LiCoO<sub>2</sub>  
2 layered oxide said electrode material prepared by a process comprising:

3 a) refluxion of a precursor solution in glacial acetic acid, wherein the precursor  
 4 is selected from a group consisting of  $\text{Al}_2\text{O}_3$ ;  $\text{Cr}_2\text{O}_3$ ;  $\text{MgO}$ ,  $\text{MgAl}_2\text{O}_4$ ;  $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$   
 5 where  $0 < x < 0.33$ ,  $0 < y \leq 2$  and  $\text{M} = \text{Ni}$  or  $\text{Co}$ ;

b) preparing a precursor solution in water, wherein the precursor is selected from a group consisting of  $\text{Al}_2\text{O}_3$ ;  $\text{Cr}_2\text{O}_3$ ;  $\text{MgO}$  and  $\text{MgAl}_2\text{O}_4$ ;

c) dispersing LiCoO<sub>2</sub> layered oxide in the precursor solution; and

9                   d) heating the dispersed LiCoO<sub>2</sub> layered oxide to approximately 100 to 500  
0                   degrees C; and

e) firing the heated dispersed LiCoO<sub>2</sub> layered oxide at 500-900 degrees C.